

Remarks

By the present amendments, Claims 17, 19-24, and 26-32 have been canceled. Claims 15 and 18 have been amended to emphasize unique features of the instant composition and the process for preparation thereof, the Claim 34 has been added to define further subject matter constituting the invention.

The drawings have been amended by deleting Figure 6 and Figure 9, which are, respectively, redundant of Figures 8 and 7. The values set forth in the table of Figure 6, as filed, were however truncated, but were correctly set forth in original Figure 8; accordingly, original Figure 8 is retained and renumbered (on the Replacement Sheet) as Figure 6. A full set of drawings, designated sheets 1/5 through 5/5, is submitted herewith; they may be substituted for the drawings of record, if deemed desirable, albeit no changes, other than those discussed above, have been made.

The specification has been amended to correct obvious inconsistencies, and also to conform the descriptions of and references to the drawings with the amendments herewith submitted in respect thereof. No new matter is thought to have been added.

In the Office Action, the Examiner objected to Claims 17, 30, and 32. Those claims have now been canceled, and consequently the objections are moot.

Turning now to substantive matters, Claims 15 through 32 stand rejected, under 35 U.S.C. 103(a), as having been obvious to one of ordinary skill in the art over the cited Dai et al. paper, and Claim 33 stands rejected as having been obvious over Dai et al. taken in view of secondary and tertiary references. It is respectfully submitted that all pending claims, as amended, clearly define an invention that is patentable over the prior art.

The Examiner has acknowledged, in paragraph 8. of the Office Action, that the Dai et al. polymer contains an additional sulfone phthalazinone structural unit. He contends however that, because Claim 15 does not include any claim language or features of structural formula I that exclude other monomer units, the disclosed polymer reads on the polymer defined in claim.

It is Applicants' strong conviction that the Examiner is incorrect in this contention. The Dai et al. compounds are sulfonated "sulfone ketones," wherein the ketone portion is sulfonated only in one location, as shown in scheme I on page 1687, cited by the Examiner. The claimed compounds, in contrast, are sulfonated "ketones," wherein the ketone is sulfonated in two locations.

This significant distinction is in fact recognized by the Examiner in paragraph 10. of the Action, but is dismissed on the basis that the PPESK polymers are sulfonated in order to obtain higher hydrophilicity of the polymer for use in membranes.

The Examiner should appreciate that, in the presently claimed polymers, hydrophilicity is not relevant. What is relevant is the achievement of a degree of sulfonation (DS) in a defined range of 0.6 to 1.2; it is that feature which provides the requisite properties for use of the material in PEM fuel cells.

In paragraph 10. the Examiner also states: "Conversely, increasing DS will eventually sulfonate the phenyl group attached to the ketone group." This logic escapes Applicant. Indeed, it is submitted that sulfonation is an electrophilic reaction, which depends upon the correct amount of electron density in the ring being sulfonated.

In any event, the properties of the sulfonated PPESKs disclosed in Dai et al. are quite different from the presently claimed sulfonated PPEKs. In particular, for use as PEM membranes, for example to replace the well known Nafion[®] membranes, the conductivity is most significant. The Examiner's attention is directed to the instant specification, at page 17 in the paragraph headed "**Conductivity**" and to Figure 7, wherein it is shown, by direct comparison, that the PPEKs according to the invention are superior to the PPESKs; i.e., for the intended purpose as PEMs for fuel cells.

Furthermore, by the present amendment Claim 15 has been restricted to a selected group of compounds, of structural formula I, in which the degree of sulfonation (DS) is in the range of 0.6 to 1.2, as supported in Table 1 of the specification. It is emphasized that the claimed compounds, having a DS in the range of 0.6 to 1.2, are well suited as PEM materials since, as is stated in the specification on page 6 at lines 22-23, at a higher DS of 1.3 "SPPEK is water soluble and can not be used as a PEM in a fuel cell where high humidity exists."

The Examiner's attention is also drawn to lines 25-30 on page 6 of the specification, at which location the process conditions for a DS in this range are stated, with reference to Table 1. Accordingly, process Claim 18 has been amended to be of corresponding scope to composition Claim 15.

Claim 18 has also been amended to include the features of Claims 20 and 21, in regard to which it is submitted that, even if it were obvious to combine the concentrated sulfuric acid and fuming sulfuric acid (oleum) of Dai et al. in a single sulfonating agent composition (which Applicants do not concede), the concentration of the fuming sulfuric acid is significantly higher in the present composition. The significance of varying the

sulfonating agent is explained in detail in the instant specification, at page 6, and is supported by Table 1.

Clearly, this difference in composition does not result in the same properties, as alleged by the Examiner in paragraph 13. of the Action. As discussed above, Figure 7, and the specification at page 17, provide a direct comparison of the properties of SPPEKs according to the instant invention, and SPPEKs. Accordingly, it is submitted that this assertion is without merit, and cannot support a valid rejection.

Turning now to paragraphs 14 to 19 of the Office Action, the Examiner rejects Claim 33 as having been obvious over Dai et al., taken in combination with supplemental references. He alleges that, since Dai et al. discloses that the SPPEK membrane was stable up to 120° C and even up to 130° C, it would be expected to have utility in a SPEM system.

In view of the fact that the claimed membrane is itself patentable over Dai et al., the stability of the Dai et al. SPPEKs in the aqueous environment of the reference, at high temperature, is irrelevant to the patentability of the claimed membrane electrode assembly. Indeed, many similar polymers have such stability, but require testing to determine applicability in PEM systems.

Finally, newly submitted Claim 34 defines the use of the sulfonated poly(phthazinones) of structural formula I (as recited in Claim 15) as a solid polymer electrolyte membrane in a fuel cell. Again, for the reasons set forth hereinabove, the subject matter of Claim 34 is believed to be manifestly allowable.

In view of the foregoing amendments and remarks, it is respectfully submitted that all pending claims define an invention that is novel and patentable over the prior art.



Withdrawal of all objections and rejections, and passage of the application to allowance, are believed to be clearly in order. Such actions are earnestly solicited.

Enclosed herewith is a Petition for Extension of Time, together with Form PTO-2038 authorizing a charge in the required amount.

Respectfully submitted,
YAN GAO, ET AL.

By

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CERTIFICATE OF MAILING

I, IRA S. DORMAN, hereby certify that this Amendment In Response to Office Action and five Replacement Sheet of drawings, together with a Petition for Extension of Time and Form PTO-2038, are being deposited with the United States Postal Service, as First Class mail, postage prepaid, in an envelope addressed as set forth on the first page hereof, on February 24, 2009.

cc: J. Wayne Anderson, Esq.

IN THE DRAWINGS

Cancel Figures 6 and 9. Amend Figure 8 to redesignate it Figure 6, as set forth on the accompanying Replacement Sheet.